report of the Government Commissioner, Sir E. J. Reed, directed attention to imperfections in this department of shipbuilding practice, and furnished a powerful stimulus to renewed inquiry. Valuable results were speedily forthcoming in the shape of more complete and general expositions of the theory of stability than had previously been given: and in a great simplification, which at the same time included an extension, of the system of calculation. One of the most useful portions of the present work is that which describes the improvements thus made in the theory and practice of the subject.

The modern improvement of the theory is shown by Sir E. J. Reed to be in the direction of considering the variation of stability with draught of water, and the amount of stability a ship will possess at light draughts. The *Daphne* inquiry showed that the danger of instability which is sometimes to be found associated with light draught of water was frequently lost sight of because of a prevailing belief that, so long as a vessel has a high side out of water, and any initial stiffness, she will have a large range of stability. This point is clearly and fully dealt with by Sir E. J. Reed in his present work; and he states a general proposition which underlies it, and which was first enunciated by Prof. Elgar in the *Times* of September 1, 1883. It is that, if any homogeneous body which is symmetrical about the three principal axes at its centre of gravity be of such density as to float in equilibrium with its lowest point at a depth x below the water, then if the density be altered so as to make it float with its highest point at a height x above the water, the righting moments will be the same in both cases at equal angles of inclination, and, consequently, the range of stability and complete curves of righting moments will be the same. Sir E. J. Reed also gives copious extracts and diagrams from a paper read by Prof. Elgar before the Royal Society in March last, in which the variation of righting moment with draught of water is shown not only for symmetrical bodies, but also for floating bodies of irregular form and for an actual ship. These investigations indicate that the effect of lightness of draught upon stability may be as prejudicial, or even more so, than that due to low freeboard.

Sir Edward Reed deals very fully with the recent practical developments of the subject, and with the improved systems of calculation that have been devised. These have for their primary object the direct construction of curves showing the variation of righting arm with draught of water at fixed angles of inclination. The wedges of immersion and emersion are no longer dealt with in the stability calculations. Atwood's formula involving the volumes and moments of the wedges of immersion and emersion is discarded, and the following one is employed (see Fig. 1) $GZ = BR - BG \sin\theta$. BR is computed by calculating the under-water volume at the inclined water-line $W'L'$, and its statical moment. These calculations can be made very quickly and easily with the aid of Amsler's mechanical integrator: and the complication involved by dealing with the two separate wedges, and equating their volumes, may thus be avoided. Sir Edward Reed describes the methods put forward by Mr. W. Denny—who appears to have been the first to suggest this important step—Mr. Macfarlane Gray, Mr. Benjamin, and others.

It is singular that while naval architects in this country were thus working out for themselves those extensions of the difficult problem of stability which modern requirements have demanded with continuously increasing force, the French appear to have been long in possession of a complete and admirable system. So long ago as 1863 M. G. Dargnies was making calculations of stability at Marseilles for numerous angles of inclination, and for four or five draughts of water; and in 1864 M. Reech put forward a most ingenious and perfect method for bringing all the probable stability conditions of a ship into full view and under calculation. The advantages of this method were so striking that it was not long in becoming practically adopted in France, and, in 1870, M. Risbec prepared a paper upon it, together with a calculation form for facilitating its application. Sir Edward Reed gives a concise and clear exposition of the systems of MM. Dargnies, Reech, and Risbec, together with an example of M. Risbec's calculation form. The investigations of MM. Ferranty and Daymard are also described in detail. The latter are probably better known in this country than any of the others referred to, in consequence of a paper which M. Daymard read upon the subject before the Institution of Naval Architects in April last.

There is much in this large and important work to which it is hardly possible to refer, still less attempt an adequate discussion of, within the limits of a short review. We shall return to the subject in a future number. In the meantime, all who are interested in this branch of science, and its bearing upon the construction and safe treatment of ships, will do well to refer to the book itself for full and precise information upon the various aspects of the theory of stability and its practical applications. Fundamental principles are clearly described and illustrated, and may be readily understood by persons possessing an elementary knowledge of mathematics. On the other hand, the elegant and extensive investigations of Dupin, Leclert, Guyou, Moseley, Woolley, and others furnish profitable subjects of study for the most advanced of mathematicians.

(*To be continued.*)

OUR BOOK SHELF

Natural History Sketches among the Carnivora, Wild and Domesticated; with Observations on their Habits and Mental Faculties. By Arthur Nicols, F.G.S., &c. (London: L. Upcott Gill, 1885.)

THIS little volume of some 250 pages is full of interest: treating somewhat of lions and tigers, it has a pleasant portion of a chapter about cats, but the bulk of the volume is devoted to man's faithful friend, the dog. Of the several excellent illustrations we would especially mention the life-like one of a lioness watching its prey, from a drawing by Mr. J. T. Nettleship, which is very full of vigour and muscular force, one of the black-maned African lion, by Mr. C. E. Brittain, and one of Chang, Mr. G. B. Du Maurier's Grand St. Bernard, by Mr. T. W. Wood. As one of the interesting subjects touched on by Mr. Nicols, we may allude to that treating of the sense of smell in dogs. He alludes to this in connection with the habit possessed by some dogs of rolling in decaying animal, or even vegetable, substances. On one occasion Mr. Nicols noticed his retriever vigorously anointing himself by rolling about in a clump of living fungi which emitted a particularly evil smell. This is thought to be an inherited habit, or, as Mr. H. Dalziel writes, "Taste and smell being

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closely allied senses, this rolling causes pleasurable sensations from association with the glorious feasts enjoyed on battle-fields and on putrid carcases of animals," and from this the author hints that possibly, and even probably, when grouse or venison come to our tables in a state of actual decomposition, this represents a taste acquired years ago by the conditions of a primitive life, and is not to be distinguished from a habit which brings upon our domestic dogs the severest reprobation and prompt chastisement. It seems a subject, however unsavoury, well worthy of being investigated, and doubtless many facts bearing on it in reference to uncivilised people are yet to be narrated. Once we call to mind a small knot of semi-civilised Africans captured in a slave dhow off Mosambique that we interrupted at a midnight feast; they were partly eating and partly smelling a mass of half-putrid fish, which seemed, to say the least, to make them uproarious. They had been under civilisation of a sort since their infant days, but seemed full of hereditary instincts. Mr. Nicols's work is full of his own careful observations, and forms a most pleasant addition to our knowledge of the habits and mental faculties of the Carnivora.

Entwickelung der Ortschaften im Thüringerwald. Von Dr. F. Regel. *Petermann's Mitteilungen*, Ergänzungsheft No. 76. (Gotha: Perthes, 1885.)

THIS is a very complete account of the origin and development of the towns and villages in the region known as "the Thuringian Forest," with a special chapter on the geology, topography, and climatology of the district, and a valuable map. The "Thuringian Forest" extends from Eisenach, on the north-west, to Schleusingen, on the south-east, and covers an area of about 1200 kilometres, with a population of 143,986. The mountains of this region are mainly composed of granite, gneiss, palæozoic strata, and porphyry. About a third of the district is still covered with wood. Formerly there was a great variety of trees, comprising the pine, oak, beech, birch, elder, maple, aspen, and willow; but now the forests consist almost entirely of pines, with a few beech woods between Friederichroda and the mediæval walled town of Schmalkalden. The average temperature is somewhat lower than that of the whole of Germany. In the higher villages neither wheat nor the finer kinds of fruit will thrive, and there is frost during from ten to eleven months in the year. The climate, however, is very healthy, and the beauty of the scenery and purity of the mountain streams attract many visitors during the summer months. The highest, and one of the most popular, of these summer resorts is Oberhof, a village at the top of the pass over the Schützenberg, of which the earliest record is in the year 1267. Only oats and potatoes can be grown here (2541 feet above the sea-level), and even the house-sparrow cannot be acclimatised. Eisenach, the capital of the district, is chiefly known on account of the confinement of Luther in the neighbouring castle of Wartburg, which was erected to guard the Thuringian frontier on the west in the years 1067 to 1070. This fortress was close to the junction of two important roads from Erfurt and Mühlhausen, and, as usual in such cases, a town rapidly grew up at the foot of the hill on which the fortress was built. Eisenach now has 13,000 inhabitants, with three churches and several factories. Other towns and villages not so favourably situated owed their development to the neighbourhood of mines, healing waters, &c. Ruhla, a flourishing town of 4500 inhabitants, was celebrated in the first half of the sixteenth century for its steel manufactures, but foreign competition and heavy taxes nearly ruined the place, and in 1748 the population had considerably diminished. The enterprising spirit of the inhabitants, however, was soon drawn into a new channel by the discovery of mineral waters and the introduction of the manufacture of carved amber and pipe-bowls of imitation meerschaum, an industry which has attained considerable proportions. A somewhat similar history is that of the manufacturing town of Ilmenau, which is first mentioned in the chronicles of the fourteenth century. It flourished as an important centre of the copper-mining district of the Ilm up to the year 1739, when the mines were flooded by an inundation. In 1752 the town was burnt to the ground, and, though partly rebuilt, it shared in the general distress caused by the seven years' war, and did not revive until the beginning of the present century, when the manufacture of glass, porcelain, and toys was introduced. In 1838 the establishment of a hydropathic institution afforded a further stimulus to the trade of Ilmenau, and the population has increased from 1972 in 1809 to 4593 in 1880. On these and other places of less note in the Thuringian Forest Dr. Regel's work affords abundant information, though it is somewhat overcharged with notes and references which serve rather to display the extent of the author's reading than to illustrate his text.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

River Thames—Abnormal High Tides

REVERTING to my letter of December 19, 1883, inserted in NATURE for January 10, 1884, I append an abstract of salient exceptional tides of last year similar to that accompanying my former letter, from which it will be seen that the maximum elevation of tide is eleven inches less than in 1883, and the excess over the computed rise is also less by seventeen inches than in 1883—in each year resultant on north-north-west gales. Both year's results may be said to be analogous, and each showing how sensitive is the high-water level and how easily it is affected and raised by a change from south and west to northerly winds.

High Waters referred to "Trinity"

1884		Computed	Observed	Difference	Wind
		′ ″	′ ″	′ ″	
Jan.	12 p.m.	0 3 above	1 6 above	1 3	W.N.W.[1]
,,	24 a.m.	3 0 below	0 6 below	2 6	W.N.W.[1]
,,	31 p.m.	0 10 above	2 0 above	1 2	W.S.W.
Feb.	1 ,,	0 10 ,,	2 0 ,,	1 2	W.S.W.
,,	14 ,,	0 8 ,,	2 0 ,,	1 4	W.N.W.[2]
,,	25 ,,	0 10 below	0 3 ,,	1 1	W.N.W.[2]
Mar.	11 ,,	0 2 above	1 9 ,,	1 7	N.[2]
,,	12 ,,	0 6 ,,	2 5 ,,	1 11	W.S.W.[3]
,,	26 ,,	0 2 ,,	1 3 ,,	1 1	E.N.E.
April	22 ,,	2 1 below	0 6 ,,	1 7	E.N.E.[4]
June	7 ,,	1 0 ,,	0 3 ,,	1 3	N.N.E.
,,	25 ,,	1 1 above	2 3 ,,	1 2	N.N.W.
July	8 ,,	0 10 below	0 3 ,,	1 1	S.S.E.
,,	9 ,,	0 6 ,,	0 6 ,,	1 0	S.S.E.
,,	25 ,,	1 0 above	2 0 ,,	1 0	N.N.W.[5]
Aug.	16 a.m.	2 3 below	1 0 below	1 3	S.
,,	25 p.m.	0 3 above	1 4 above	1 1	N.
Sept.	2 ,,	2 7 below	1 6 below	1 1	W.S.W.
,,	5 ,,	"Trinity"	1 6 above	1 6	W.N.W.[6]
,,	22 ,,	0 7 above	1 9 ,,	1 2	W.
Nov.	6 ,,	1 4 ,,	2 9 ,,	1 5	E.N.E.[7]
Dec.	20 ,,	0 5 below	1 9 ,,	2 2	N N.W.[8]
,,	22 ,,	0 9 ,,	0 6 ,,	1 3	N.

J. B. REDMAN

6, Queen Anne's Gate, Westminster, S.W., January 5

Our Future Clocks and Watches

IT is to be hoped that the absurd dial of which you give a drawing will not come into general use. Why not adopt the convenient shape which for more than a century has been in use

---

[1] Wind Influence.
[2] Northerly Influence.
[3] Still felt.
[4] Wind blowing right up the estuary.
[5] Sewage up to Westminster with this tide.
[6] N.N.W. day before.
[7] Maximum tide of year; W.N.W. gale day before.
[8] Gale and remarkable fall of barometer = 29″ 10′.

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